

Aerobiology of *Juniperus* pollen in Oklahoma, Texas, and New Mexico

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Background: Pollen from members of the Cupressaceae are major aeroallergens in many parts of the world. In the south central and southwest United States, *Juniperus* pollen is the most important member of this family with *J. ashei* (JA) responsible for severe winter allergy symptoms in Texas and Oklahoma. In New Mexico, pollen from *J. monosperma* (JM) and other *Juniperus* species are important contributors to spring allergies, while *J. pinchotii* (JP) pollinates in the fall affecting sensitive individuals in west Texas, southwest Oklahoma and eastern New Mexico. Throughout this region, JA, JM, and JP occur in dense woodland populations. Generally monitoring for airborne allergens is conducted in urban areas, although the source for tree pollen may be forested areas distant from the sampling sites. Improved pollen forecasts require a better understanding of pollen production at the source. The current study was undertaken to examine the aerobiology of several *Juniperus* species at their source areas for the development of new pollen forecasting initiatives.

Methods: Burkard volumetric samplers were established at six Texas or Oklahoma woodland sites for two winter seasons (2009-2010 and 2010-2011) to monitor JA pollen and for two fall seasons (2010 and 2011) to monitor JP pollen. In New Mexico samplers were established at six sites for two spring seasons (2010 and 2011) for JM and other *Juniperus* pollen. In addition, ongoing sampling at the University of Tulsa provided data for local *J. virginiana* (JV) pollen as well as evidence of long distance transport of JA and JP. Standard methods were used for the preparation and analysis of Burkard slides. Season start date was defined as 1% of the cumulative season total and end date as 99% of total. Meteorological data were obtained from the NWS stations close to each sampling site and the Oklahoma Mesonet. Wind trajectories were calculated using NOAA HYSPLIT dispersion model.

Results: Pollen concentrations varied greatly across all sampling locations for each species and for each season. For JA the highest seasonal pollen concentrations occurred during the 2009-2010 season at Junction, Texas with the mean seasonal concentration of 1,285 pollen/m³ and the lowest was during the 2010-2011 season at Sonora, Texas with a mean of 484 pollen/m³. The highest single day concentration for JA (18,073 pollen/m³) was recorded at Junction on 18 Jan 2010, and the peak hour during that day was 70,367 pollen/m³. In New Mexico, the highest seasonal pollen concentrations were registered at Santa Fe in 2010 with a seasonal mean of 1,647 pollen/m³ and the lowest season concentration was recorded at Mountainair in 2011 with a mean of 39 pollen/m³. The peak one-day concentration (16,171 pollen/m³) was recorded at Santa Fe on 30 Mar 2010 with the peak hourly concentration of 52,198 pollen/m³. For JP the highest seasonal concentration was recorded at Quanah, Texas with 4,463 pollen/m³ in 2010, while the lowest seasonal concentration occurred at Erick, Oklahoma in 2011 with a season concentration of 18

pollen/m³. The peak one-day concentration of JP (25,758 pollen/m³) occurred on 18 Oct 2010 at Quanah, Texas with the peak hourly concentration of 67,160 pollen/m³. The extreme heat and drought in Texas and Oklahoma during the summer of 2011 resulted in significantly lower concentrations of JP pollen during 2011 at all locations. In Tulsa *Juniperus* pollen was present in the atmosphere for 7 months each year. Local JV pollen was registered from February through April. The mean seasonal concentrations were 169 pollen/m³ in 2010 and 92 pollen/m³ in 2011. Peak concentrations these years were 1,900 and 1,564 pollen/m³, respectively. In addition, incursions of JA pollen were present during December and January and incursions of JP pollen were registered in October and November. Forward HYSPLIT trajectories from the woodland sampling locations and backward trajectories from Tulsa for the periods of these incursions confirm the source areas and *Juniperus* species.

Conclusions: Very high concentrations of *Juniperus* pollen were recorded in natural populations of JA, JM, and JP. Sampling in Tulsa confirmed the incursions of JA and JP pollen proving that woodland populations of allergenic plants are an important source of pollen that can impact sensitive individuals at downwind locations. Improved pollen forecasting is needed to consider local, regional, and distant sources of airborne pollen. The data collected during this study will hopefully contribute to the development of these forecasting models.